

# WORLD COTTON RESEARCH CONFERENCE-3



## COTTON PRODUCTION FOR THE NEW MILLENNIUM



9 - 13 MARCH 2003 • CAPE TOWN, RSA



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Cape Town, South Africa, 9-13 March 2003

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# Advances in participatory cotton breeding in Benin

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## ABSTRACT

The main objectives of the participatory cotton breeding program in Benin are (1) to improve the information flow between producers and researchers, particularly for a better understanding of users requirements, (2) to breed for genotype  $\times$  environments interactions in four typical agro climatologic sites. The original population was composed of intercrossing 14 genotypes of diverse origins. Four breeding cycles have already been accomplished. In each cycle, 200 plants are chosen on the three sites managed by farmer-breeders as well as on the one managed by formal breeders. Out of these, the best 50 are finally selected jointly by farmers and researchers for the quality of their fiber and sown as a mixture the following year. The populations selected in all four sites are compared with the original population and two commercial cultivars in a five locations trial in order to evaluate the genetic progress realized at each site. Results are summarized throughout a Principal Component Analysis including yield, earliness and plant development characteristics. They show that (1) genetic progress occurs in all selected populations, (2) breeding sites are easily differentiated, (3) farmer-breeders populations are more productive and (4) populations selected by formal breeders are less developed. Next steps will include stabilizing the populations and quantifying the respective effects of Environment and Breeder on these results.

## Introduction

Cotton breeding in French speaking Africa has been successful in transmitting improved genetic material to farmers. Breeders were able to gather a lot of information and to combine them in some sort of a crop ideotype to match all users requirements.

As institutional environment changes, producers tend to become majors actors of the cotton industry and cotton research needs to strengthen its links with them. That is why a participatory cotton-breeding program was initiated in 1995.

In this paper, we evaluate the genetic progress obtained through this design, especially the one obtained by farmer-breeders after four selection cycles.

## Experimental procedure

Design, genetic material and methods are de-

scribed in Sèkloka *et al.* (2002). A highly variable population was grown in four different environments where different selection pressures occurred due to different environments as well as breeders (Figure 1). At each location and cycle, 1000 were planted and each breeder chose 200 plants in his field. After fiber technological traits measurements, only 50 plants were selected. A same quantity of seeds (50 g) from these 50 plants were mixed to constitute the next breeding generation

In 2001, 12 populations (Figure 2) were compared in four locations with the original population AGP0 as well as with local cultivars (STAM 18A and H279-1). The material was included in a Fisher block layout with five replications. A Principal Component Analysis was performed with STAT-ITCF (Philippeau, 1992) on 13 agro-morphological traits, six considered as main and seven as supplementary.

## Results

### Genotypes

Individual populations and checks results are presented in Table 1. All three farmer-bred populations reached an average level of productivity that was comparable to the better check (H 279-1). First fruiting branches were high, indicating lateness. Although early, research-bred population performed poorly ( $-150\text{kg}\cdot\text{ha}^{-1}$ ). Among farmer-bred populations, Savalou was the latest (FFL, FBO, EAR), the hairiest and the most vegetative. Djougou was the earliest.

### PCA

The first two PCA axes accounted respectively for 43,5% and 28,8% of the total variation (Table 2). First axis was well correlated with earliness (FFL), number of vegetative branches (VBN) and hairiness (HAI). It opposed early, smooth genotypes and late, hairy genotypes bearing numerous vegetative branches. Second main axis was correlated with the total number of bolls (BNB), the fruiting branches length (FBL) and the total plant height (PHG). It opposed tall and productive genotypes with smaller and less productive ones. In the two axis plan, the 3 farmer-breeding groups were relatively distinguishable from each other and from the research-bred one (Figure 3). Djougou's group of genotypes faced Savalou's (late, vegetative and hairy). The lower part of the second axis is occupied by Kandi's tall genotypes with numerous bolls. The research group stayed in the center of the graph.

## Conclusions

These results show that genetic changes occurred in all populations groups and breeding sites are easily differentiated from each other. The populations of Savalou look more productive and late. This project have created genetic variability and selected material. Farmers are involved in this process by there collabo-

rative and collegial contributions (Sperling *et al.*, 1996). Farmer-breeders have proved their ability to perform efficient breeding. After several years of work in common with scientists, they are also able to use more sophisticated breeding techniques necessary to produce stabilized lines. These lines will soon be available for generalized on farm testing under contrasted environments and cropping conditions.

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**Table 1.** Mean performances of the 15 genotypes.

	Main variables						Secondary variables						
	FFL (days)	HAI (0-4°)	YLD (kg/ha)	FBL (cm)	VBN	BNB	FBO (days)	EAR (%)	PHG (cm)	LFB (cm)	FFB (cm)	FFN	VBL (cm)
STAM 18 A	58,3	2,7	1594	38,3	2,1	15,1	109,7	57,6	110,9	89,6	16,5	5,7	52,7
H 279-1	56,8	3,0	1749	37,4	1,9	14,1	108,3	61,2	104,4	85,1	15,4	5,5	47,6
AGP 0	58,5	2,7	1587	33,3	1,8	13,3	110,7	57,5	102,3	82,6	16,5	5,4	44,5
Djougou 2	57,4	3,0	1574	35,1	2,3	13,3	110,3	58,3	103,7	83,1	17,9	5,7	49,7
Djougou 3	56,6	2,7	1728	35,2	2,4	13,3	110,1	56,2	104,7	85,9	18,1	5,7	51,1
Djougou 4	57,1	2,6	1723	36,8	2,4	14,7	110,1	56,7	105,1	87,1	17,6	5,7	54,0
Kandi 2	58,6	2,9	1629	35,1	2,5	15,7	110,6	54,4	105,0	86,1	18,4	6,0	53,3
Kandi 3	58,9	2,8	1722	39,4	2,5	15,8	110,4	53,0	110,3	90,0	18,0	5,7	57,9
Kandi 4	58,4	2,8	1655	35,5	2,4	14,8	109,9	55,4	107,2	86,9	17,6	5,7	53,2
Okpara 2	59,0	2,7	1533	34,9	2,3	14,6	110,5	53,1	107,6	90,3	18,4	6,0	50,3
Okpara 3	58,1	3,0	1576	35,6	2,3	14,7	110,7	57,7	108,3	88,3	17,7	5,8	52,8
Okpara 4	57,7	2,8	1527	35,1	2,2	13,5	110,2	61,8	103,6	82,4	17,1	5,7	53,2
Savalou 2	59,0	3,4	1692	33,3	2,7	14,4	112,1	48,8	107,5	88,2	20,2	6,2	58,9
Savalou 3	59,7	3,4	1694	33,1	3,1	13,8	111,9	47,4	106,9	85,2	21,1	6,3	58,7
Savalou 4	60,2	3,3	1683	34,2	2,7	14,2	111,9	49,0	106,4	88,3	18,8	5,9	55,1
Means	58,3	2,9	1644	35,5	2,4	14,4	110,5	55,2	106,3	86,6	17,9	5,8	52,9
CV	0,9	5,4	6,1	6,7	8,8	11,6	0,5	4,3	3,3	4,6	7,0	3,5	9,5
Locations	2	4	4	3	3	3	3	4	3	3	2	3	3
F inter.	0,99	2,46	0,94	0,86	1,23	1,01	1,30	2,36	1,05	1,55	0,76	1,30	1,31
SE	0,5	0,2	101	2,4	0,2	1,7	0,5	2,4	3,5	4,0	1,3	0,2	5,0

### Main variables

FFL: first flower (days after emergence); HAI: hairiness (0 to 5); YLD: seed cotton yield (kg.ha<sup>-1</sup>); FBL: length of the longest fruiting branch (cm); VBN : number of vegetative branches; BNB : total number of bolls.

### Secondary variables

FBO: first open boll (days after emergence); EAR: Earliness (First yield weight/Total yield ; weight %); PHG: Plant height (cm); LFB: Height of the last fruiting branch (cm); FFB: Height of the first fruiting branch (cm); FFN: First Fruiting branch node; VBL: Length of the longest vegetative branch (cm)

**Table 2.** Eigen values and proportion of variation associated with the three axis and eigen vector of traits for 13 agro-morphological traits.

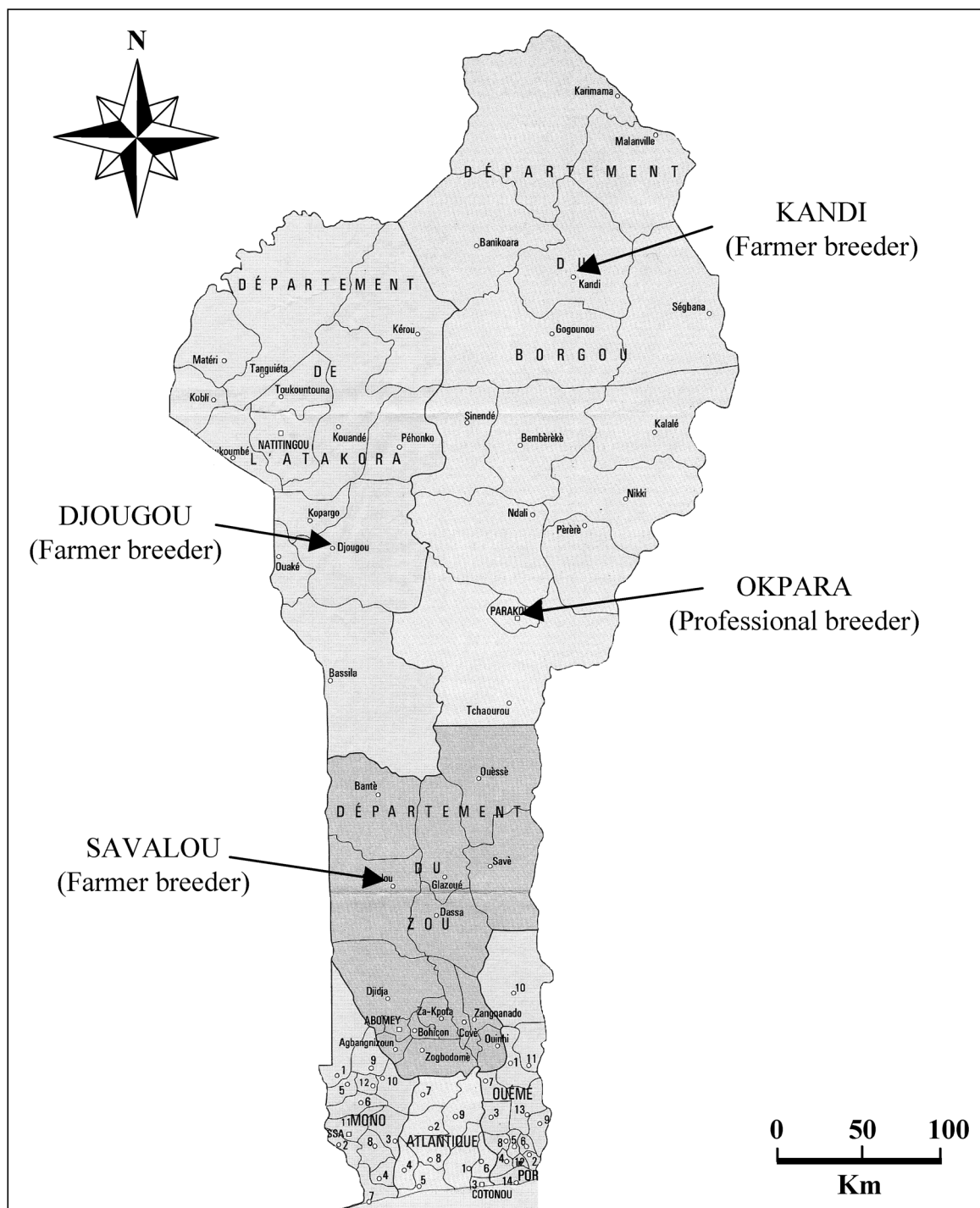
	Axis 1	Axis 2	Axis 3
Eigen value	2.6096	1.7282	1.1048
Total variation contribution	43.5%	28.8%	18.4%
<b>Mains variables</b>			
FFL: First flower (days after emergence)	<b>0.8940</b>	-0.1729	0.2524
HAI: Hairiness (0 to 5)	0.8224	0.1710	-0.4004
YLD: Yield (kg.ha <sup>-1</sup> )	0.0202	-0.3538	-0.9100
FBL: Length of the longest fruiting branch (cm)	-0.5460	<b>-0.7623</b>	-0.0173
VBN: Number of vegetative branches number	<b>0.9059</b>	-0.3109	0.0962
BNB: Total number of bolls	0.1220	<b>-0.9306</b>	0.2076
<b>Secondary variables</b>			
FBO: First open boll (days after emergence)	0.7998	0.2140	0.0291
EAR: Earliness (First yield weight/Total yield weight %)	-0.8101	0.1392	0.2051
PHG: Plant height (cm)	0.2682	-0.7248	0.1575
LFB: Height of the last fruiting branch (cm)	0.2037	-0.7108	0.1105
FFB: Height of the first fruiting branch (cm)	0.7401	0.0955	-0.1673
FFN: First Fruiting branch node.	0.7615	-0.0351	-0.0394
VBL: Length of the longest vegetative branch (cm)	0.5823	-0.4227	-0.2176

**Main variables**

FFL: first flower (days after emergence); HAI: hairiness (0 to 5); YLD: yield (kg.ha<sup>-1</sup>); FBL: length of the longest fruiting branch (cm); VBN: number of vegetative branches; BNB: total number of bolls.

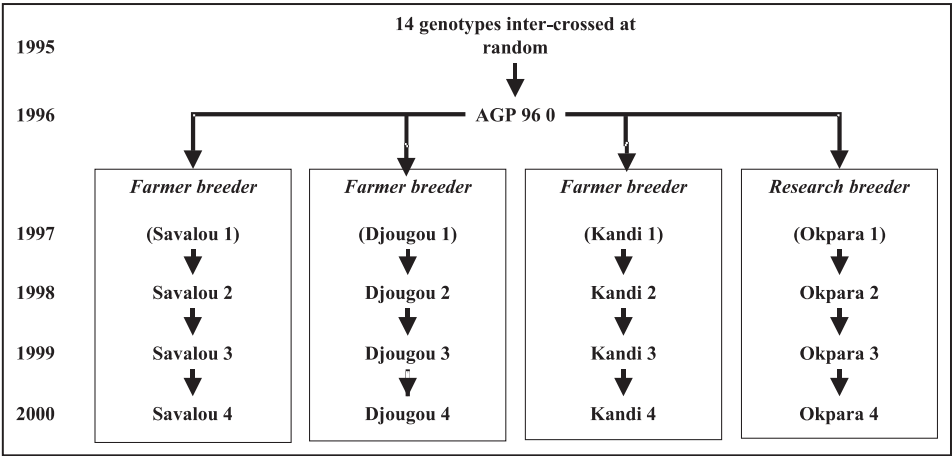
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**Figure 1.**  
*Farmer-breeders and research-breeders sites.*

**Figure 2.**  
Breeding steps  
and genetic  
material  
produced.



**Figure 3.**  
Scatter diagram  
for the 15  
genotypes.

